UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte JYOTI MAZUMDER, DWIGHT MORGAN, TIMOTHY W. SKSZEK and MATTHEW LOWNEY

Appeal No. 2005-0891
Application No. 09/916,566

ON BRIEF

Before FRANKFORT, BAHR and SAADAT, Administrative Patent Judges.

BAHR, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1 and 3-8, which are all of the claims pending in this application. Claim 2 was canceled in an amendment filed with the brief, which was entered by the examiner (answer, page 2).

We AFFIRM-IN-PART.

BACKGROUND

The appellants' invention relates to a direct metal deposition (DMD) system and method using a rapid-response diode laser source. Claims 1 and 5 are illustrative of the invention and read as follows.

> 1. A system for automatically controlling the build-up of material on a substrate, comprising:
>
> a controllable semiconductor diode laser having a beam directed to a localized region of the substrate so as to form a melt pool thereon;
>
> a material feeder for feeding material into the melt pool to be melted by the beam to create a deposit having a physical attribute;
>
> an optoelectric sensor operative to output an electrical signal as a function of the physical attribute; and
>
> a feedback controller operative to automatically adjust the rate of material deposition as a function of the electric signal by modulating the laser to control the power of the beam.
>
> 5. A method of depositing material on a substrate, comprising the steps of:
>
> heating the substrate with a high-power, rapid-response diode laser to create a melt pool in a laser interaction zone;
>
> feeding material into the melt pool to create a deposit having a physical dimension;

monitoring the laser interaction zone to generate an optical signal indicative of the physical dimension; and

controlling the deposition using the optical signal.

Claims 1 and 3-8[1] stand rejected under 35 U.S.C. § 103 as being unpatentable over Jeantette[2] in view of Kar[3].

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellants regarding the above-noted rejection, we make reference to the answer (mailed August 25, 2004) for the examiner's complete reasoning in support of the rejection and to the brief (filed May 21, 2004) for the appellants' arguments thereagainst.

OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellants' specification and claims, to the applied prior art references, and to the respective positions articulated by the appellants and the examiner. As a consequence of our review, we make the determinations which follow.

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[1] Although the statement of the rejection on page 3 of the answer does not include claims 3-8, it is apparent from the explanation of the rejection that claims 3-8 are also rejected as being unpatentable over Jeantette in view of Kar.

[2] U.S. Pat. No. 6,046,426, issued April 4, 2000 to Jeantette et al., on an application filed July 8, 1996.

[3] US Pat. No. 6,526,327, issued February 25, 2003 to Kar et al., on an application filed Dec. 7, 2000, which was a division of an application filed December 28, 1998, and claiming the benefit of a provisional application filed January 12, 1998.

Jeantette discloses a method and system for producing complex-shape objects comprising a controllable laser L having a beam directed toward a localized region on a deposition stage S , a powdered material feeder F and delivery system N for feeding powdered material in a converging, conical pattern intersecting the minimum diameter of the laser beam, thereby resulting in melting of the powdered material by the laser beam, an optical pyrometer coaxially aligned with the laser beam to monitor the temperature of the molten powder material and a feedback controller for outputting an exposure error signal which is used to control the laser output power either through direct control of the laser power supply or through the use of a continuously variable beam attenuator (column 10, first paragraph). As explained in the second paragraph in column 10, the pyrometer provides an electrical signal 112 which is proportional to the temperature at the deposition area, the signal 112 then being input to a comparator circuit 114 which compares the measured temperature value to a desired temperature value 116 and produces an error signal 118 proportional to the difference between values 112 and 116. The error signal 118 is then input to the ratiometer 108 to alter the target exposure ratio value to control the laser output power as explained in column 10, first paragraph. Jeantette teaches that "[t]he method of laser power control will be dictated by the bandwidth of the attenuation mechanism" and that, for the disclosed application, a response time of <1 ms is desired.

The examiner concedes that Jeantette does not disclose that the laser used is a diode laser as called for in claims 1 and 5 but also points out that Jeantette discloses that, while a cw or pulse Nd:YAG or CO_2 laser will work for the system disclosed therein, "any laser with sufficient power and reasonable absorption to melt the material would suffice as a laser source" (column 9, lines 22-24). The examiner further relies on Kar, which is directed to a similar deposition manufacturing process wherein a material "such as metal, ceramics and the like powder, and wire, and the like, is delivered to a laser beam-material interaction region where it is melted and deposited on a substrate" (abstract). See Figure 1. Kar discloses that,

> [a]lthough the preferred embodiments describe using CO_2 laser and Nd:YAG lasers, the invention can use other high power lasers (i.e. Nd-based solid state lasers), and diode lasers, and the like. The invention works with continuous and pulsed lasers that supply sufficient intensity for material melting [column 8, lines 44-49].

Kar evidences that the use of diode lasers for heating and melting metal or the like powder material in a direct metal deposition system and process was well known in the art at the time of appellants' invention and that diode lasers would have been recognized by those of ordinary skill in the art as having sufficient power and absorption to melt the powder material used to form a melt pool in Jeantette. We therefore agree with the examiner that the combined teachings of Jeantette and Kar would have suggested to one of ordinary skill in the art the use of a diode laser to heat the powder material used to form the melt pool in Jeantette's system and method.

The appellants argue on page 3 that Jeantette's system "is not a system that monitors a physical attribute." We do not agree. The temperature in the deposition region monitored by the optical pyrometer of Jeantette is a "physical attribute."

Finally, the appellants argue that the control of the laser output power by a beam attenuator, as disclosed by Jeantette, does not constitute "modulating" the laser to control the power of the beam. This argument appears to be grounded on a definition of "modulating" which is narrower than that applied by the examiner. In this regard, we note that, in proceedings before it, the USPTO applies to the verbiage of claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill in the art, taking into account whatever enlightenment by way of definitions or otherwise that may be afforded by the written description contained in the appellants' specification. In re Morris, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997). Moreover, absent an express definition in their specification, the fact that appellants can point to definitions or usages that conform to their interpretation does not make the USPTO's definition unreasonable when the USPTO can point to other sources that support its interpretation. Id., 127 F.3d at 1056, 44 USPQ2d at 1029.

In this case, the examiner has interpreted "modulating" (or modulation) as "'the variation of a property of an electromagnetic wave or signal, such as its amplitude, frequency, or phase' (American Heritage Dictionary of the English language, www.dictionary.com)" (answer, page 6). The McGraw-Hill Dictionary of Scientific and Technical Terms, Fifth Edition McGraw-Hill 1994) defines "modulate" as "[t]o vary the amplitude, frequency, or phase of a wave, or vary the velocity of the electrons in an electron beam in some characteristic manner" and "modulation" as "[t]he process or the result of the process by which some parameter of one wave is varied in accordance with some parameter of another wave."

We next look to the appellants' specification to determine whether it provides an express definition of "modulate" which differs from or is more specific than the dictionary definitions alluded to above. The specification states, on page 6, that

> [t]he optical signal from the laser interaction zone is used to modulate the diode laser to control the power. Since the diode lasers can respond to signals at a rate up to 20KHz, the laser power can be finely tuned to the process at faster rate than that by CO_2 or YAG lasers and thus the deposition height.
>
> ... At block 304, logic circuitry is used to modulate the laser power, with a signal being sent to the diode laser power supply at a frequency to 0 to 20 KHz, or higher frequency, depending upon the response time of the device.

The appellants' specification also uses the term "modulated" in the following context, on page 7:

> DMD surface profit height geometry and microstructure are greatly modulated by the frequency of the feedback signal. The more than 300 times increase of the frequency will improve the process significantly and will take it to new paradigm of control of closed loop direct metal deposition.

Apart from the claims and the text cited above, the term "modulate" is not discussed elsewhere in the specification. We find in the cited portions of the appellants' specification no express definition of "modulate" or "modulating." Further, we find nothing in the specification which is inconsistent with the definition of "modulate" proffered by the examiner or implies a more limited usage of this terminology. In fact, the use of "modulated" on page 7 (cited above) implies that a broader interpretation, simply "to vary," is consistent with the underlying disclosure.

In light of the above, we conclude that "the variation of a property of an electromagnetic wave or signal, such as its amplitude, frequency, or phase" is the broadest reasonable meaning of the term "modulating" consistent with the appellants' underlying disclosure. The control of the laser output power through the use of a continuously variable beam attenuator, as disclosed by Jeantette (column 10, lines 19-25) meets this definition of "modulating" and thus satisfies the limitation "modulating the laser to control the power of the beam" in claim 1.

For the foregoing reasons, we do not find the appellants' arguments as to the patentability of claim 1 over Jeantette in view of Kar to be persuasive. We therefore sustain the rejection of claim 1, as well as claims 3 and 4 which the appellants have not separately argued apart from claim 1.

We shall not, however, sustain the rejections of claims 5-8 as being unpatentable over Jeantette in view of Kar. In rejecting these claims, the examiner states simply that "[m]ethod claims 5-8 recite steps corresponding to elements recited in system claims 1, 3 and 4, and therefore are rejected under the same rationale" (answer, page 5). The appellants have, in essence, argued that the examiner has not identified where in Jeantette each of the method steps is disclosed (see brief, page 4). The examiner's only response to this argument is to contend that, "despite minor wording differences," claims 1, 3 and 4 have identical requirements to claims 5 and 6 combined, 7 and 8, respectively, and that "[i]t would be impossible to practice the use of the system without the method [*sic*] subsequently claimed method" (answer, page 8). We note that the limitations of claim 5 are <u>not</u> identical to those of claim 1. For example, while claim 1 refers to a deposit having a "physical attribute," claim 5 refers to a deposit having a "physical dimension." Further, claim 5 recites a step of monitoring the laser interaction zone to generate an <u>optical</u> signal indicative of the <u>physical dimension</u>, while claim 1 recites an optoelectric sensor to output an <u>electrical</u> signal as a function of the <u>physical attribute</u>. An optical signal is certainly not identical to an electrical signal and a physical dimension is narrower than a physical attribute and the

examiner's rejection of claims 5-8 and response to arguments with respect to these claims do not seem to come to grips with these differences or point out where these specific steps are disclosed in Jeantette.

CONCLUSION

To summarize, the decision of the examiner to reject claims 1 and 3-8 under 35 U.S.C. § 103 is affirmed as to claims 1, 3 and 4 and reversed as to claims 5-8.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

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CHARLES E. FRANKFORT
Administrative Patent Judge

Jennifer D. Bahr
JENNIFER D. BAHR
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